Towards an understanding of the constancy (or non-constancy) of slip-rates on the North Anatolian fault

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Understanding the temporal and spatial distribution of strain storage and release on major faults is a key aspect of modern geodynamics. Over the past 15 years GPS measurements have provided increasingly detailed velocity fields along numerous plate boundaries. In contrast, in many locations too few intermediate- and long-term geologic fault slip rates exist to allow for meaningful comparisons between long- and short-term rates. We are using cosmogenic radionuclide dating of offset geomorphic features to generate slip rates for the North Anatolian fault (NAF) in Turkey at a range of time scales ranging from <2,000 to >10,000 years. One of our primary study sites is located along the central part of the fault near the village of Eksik. At the site several major south-flowing drainages have incised >25 m into a well-developed fluvial terrace. These terraces have been offset right-laterally by the east-west fault, which is manifested as a very simple, narrow zone across the study site. The terrace deposits consist almost entirely of distinctive, white limestone cobbles that contrast markedly with the underlying dark grayish-green bedrock. The inner edge of the fluvial terrace is geomorphically well-defined over most of the site, facilitating mapping of the fault offset. In addition, the inner edge of the distinctive terrace gravels is exposed in 3D in several natural side drainages. We also excavated three trenches to expose the terrace inner edge adjacent to the narrow fault zone. These exposures and our geomorphic mapping demonstrate that the inner edge of the fluvial terrace is offset by ~48.5 m across the NAF. The age of the terrace is constrained by ten ^{36}Cl cosmogenic radionuclide dates, which yield an age of ~2ka. In addition to these surface exposure dates, we dated charcoal samples from beneath the terrace deposits. These radiocarbon ages indicate a maximum, limiting age for terrace gravels of ≤2.9 ka. This provides an independent geologic minimum slip-rate of >14 mm/yr. Radiocarbon dates and surface exposure date results are in good agreement within the stratigraphic sequence. These data indicate a slip rate for the NAF over the past 2,000 years of 23.5+8.5/-6.5 mm/yr. This rate is indistinguishable from geodetic (GPS) rates of elastic strain storage across the fault, suggesting that strain storage and release have been relatively constant across the NAF, at least over the past 2 ka. Our ongoing studies of the NAF include sites with larger offsets, which should provide longer-term records of slip rate along the NAF. These longer-term rates will, in turn, allow us to assess the degree to which strain storage and release have been constant (or non-constant) throughout the Holocene. These data will provide an important point of comparison with similar continental strike-slip fault systems, such as the San Andreas fault in California.